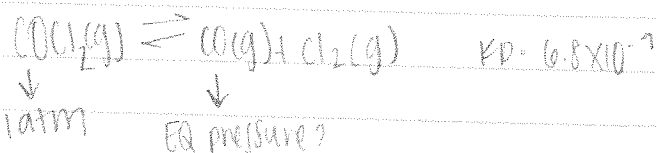


class notes 2/13

Calculating EQ concentrations from K



$$K_P = \frac{(P_{\text{CO}})(P_{\text{Cl}_2})}{(P_{\text{COCl}_2})} = 6.8 \times 10^{-9}$$

	COCl_2	CO	Cl_2
I	1 atm	0	0
C	-X	+X	+X
E	1-X	X	X

$$K_P = \frac{(X)(X)}{(1-X)} = \frac{X^2}{1-X} = 6.8 \times 10^{-9}$$

$\left. \begin{array}{l} K \text{ is small} \\ \rightarrow \text{assume } 1-X \approx 1 \end{array} \right\}$

$$X^2 = 6.8 \times 10^{-9}$$

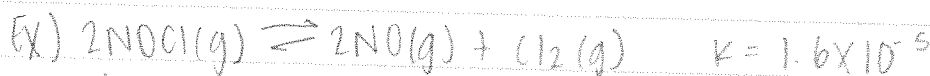
$$X = 8.2 \times 10^{-5} \text{ atm}$$

initial concentration

5% "rule"

If $\frac{X}{[C]_0} \times 100 < 5\%$ (or 0.05) GOOD TO GO!

$\rightarrow [C]_0$



1 mol $\downarrow$ 2L flask

$\downarrow$
EQ

	NOCl	NO	Cl_2
I	0.5M	0	0
C	-2X	+2X	+X
E	0.5-2X	2X	X

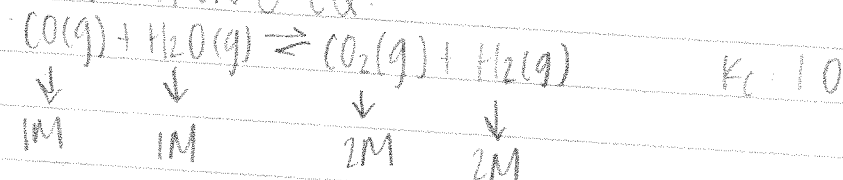
$\rightarrow$

$$K = \frac{[Cl_2][NO]^2}{[NOCl]^2} \rightarrow \frac{(x)(2x)^2}{(0.5-2x)^2} \quad * \text{assume } x \ll 0.05$$

$$K = \frac{4x^3}{(0.05)^2} = 1.6 \times 10^{-5}$$

$$x = 0.01$$

IS A REACTION @ EQ?



calculate reaction quotient (Q)

→ Q takes same form as EQ (constant K, but the values used to calculate Q are the actual current conditions)

$$Q = \frac{[CO_2][H_2]}{[CO][H_2O]} = \frac{(2)(2)}{(1)(1)} = 4 \quad K_c = 1$$

→ compare Q to K

Q > K, too many products, expect rxn to shift left to reactants

- if Q < K, rxn needs to proceed to product
- if Q = K, rxn is at equilibrium
- if Q > K, rxn proceeds to reactants

sample calculation of Q



1 L flask contains

0.024 moles NO

2 moles N₂

2.6 mol O₂

$$Q = \frac{[N_2][O_2]}{[NO]^2} = \frac{(2)(2.6)}{(0.024)^2} = 9028$$

Q > K, rxn shifts towards reactants (left)

Le Chatelier's Principle

- If a system is @ EQ and it undergoes stress, it will respond to overcome the effect of that stress



- Add H_2 or I_2 , the EQ shifts to right to use up added reactants
- remove HI , eq shifts to the right to make more product
- add HI , EQ shifts left to use up added HI
- remove H_2 or I_2 shifts to left to make more reactant

- changes in pressure/volume (gases)

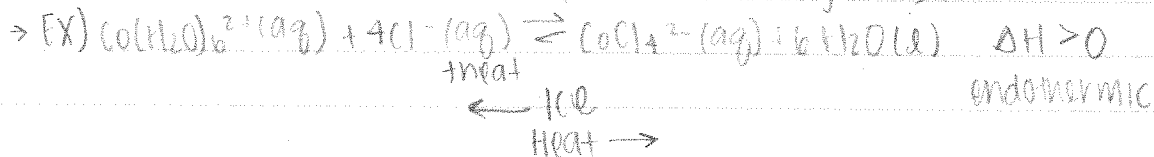
- higher volume or lower pressure favors the side of equation w/ more moles

- change in temperature

- is the rxn endothermic or exothermic

↳ endothermic: write heat as a reactant (ΔH positive)

↳ exothermic: write heat as a product (ΔH negative)



★ Ice: removing heat (reactant); heat: adding reactant